Electronic Version

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Claims

[c1] WHAT IS CLAIMED IS:

1. A magnetizing method for obtaining a permanent magnet for a motor by magnetizing a material to be magnetized, wherein:

an attenuation body made of a conductive material is arranged in contact with or close to at least one surface of the material which is nonconductive;

thereafter a magnetization field is impressed;

at least a part of magnetic flux of the magnetization field penetrates both the attenuation body and the surface in contact with or close to the attenuation body simultaneously; and

the magnetization is performed by a so-called pulse magnetic field which is rapidly intensified and thereafter weakened with respect to elapse of time.

[c2] 2. A magnetizing method according to claim 1, wherein:

the material has a platy shape or a tubular shape;

the material is magnetized in a thickness direction;

the attenuation body is located along the surface of the material on at least one side in the thickness direction; and

a surface resistance of the attenuation body expressed by Rs satisfies the formula

$$3.0 \times 10^{-5} \leq Rs \leq 1.0 \times 10^{-2}\ [\Omega/sq.] \qquad (1).$$

[c3] 3. A magnetizing method according to claim 1, wherein the magnetization field is generated by passing a pulse current through a magnetizing coil; and
the pulse current satisfies the formula

$$2.0 \times 10^{-5} \leq \Delta t \leq 5.0 \times 10^{-3}\ [sec.] \qquad (2).$$

where Δt is a time from the start of passing the pulse current until the current value reaches the maximum.

[c4] 4. A magnetizing method according to claim 2, wherein the magnetization field is generated by passing a pulse current through a magnetizing coil; and
the pulse current satisfies the formula

$$2.0 \times 10^{-5} \leq \Delta t \leq 5.0 \times 10^{-3}\ [sec.] \qquad (2).$$

where Δt is a time from the start of passing the pulse current until the current value reaches the maximum.

[c5] 5. A magnetizing method according to claim 1, wherein the material is a Nd-Fe-B bonded magnetic material.

[c6] 6. A magnetizing method according to claim 2, wherein the material is a Nd-Fe-B bonded magnetic material.

[c7] 7. A magnetizing method according to claim 1, wherein the material has a cylindrical shape;

the attenuation body is in contact with or close to any one or both of an outer circumferential surface or an inner circumferential surface of the material in such a manner as to cover in a circumferential direction;
any one or both of the outer circumferential surface and the inner circumferential surface are magnetized simultaneously;
a plurality poles are arranged alternately in a circumferential direction on the surface of the material; and
a geometry of a permanent magnet obtained from the material satisfies the formula

$$h < \pi R/P \text{ [mm]} \quad (3).$$

where P is the number of magnetized poles, R [mm] is a diameter of the circumferential surface to be magnetized in the case where one of the surfaces is magnetized, R [mm] is a diameter of the outer circumferential surface in the case where both of the inner circumferential surface and the outer circumferential surface are magnetized, and h [mm] is an axial height perpendicular to a radial direction of the material.

[c8] 8. A magnetizing method according to claim 2, wherein the material has a cylindrical shape;
the attenuation body is in contact with or close to any one or both of an outer circumferential surface or an inner circumferential surface of the material in such a

manner as to cover in a circumferential direction;
any one or both of the outer circumferential surface and the inner circumferential surface are magnetized simultaneously;
a plurality poles are arranged alternately in a circumferential direction on the surface of the material; and
a geometry of a permanent magnet obtained from the material satisfies the formula

$$h < \pi R/P \text{ [mm]} \quad (3).$$

where P is the number of magnetized poles, R [mm] is a diameter of the circumferential surface to be magnetized in the case where one of the surfaces is magnetized, R [mm] is a diameter of the outer circumferential surface in the case where both of the inner circumferential surface and the outer circumferential surface are magnetized, and h [mm] is an axial height perpendicular to a radial direction of the material.

[c9] 9. A magnetizing method according to claim 3, wherein the material has a cylindrical shape;
the attenuation body is in contact with or close to any one or both of an outer circumferential surface or an inner circumferential surface of the material in such a manner as to cover in a circumferential direction;
any one or both of the outer circumferential surface and the inner circumferential surface are magnetized simul-

taneously;

a plurality poles are arranged alternately in a circumferential direction on the surface of the material; and

a geometry of a permanent magnet obtained from the material satisfies the formula

$$h < \pi R/P \text{ [mm]} \qquad (3).$$

where P is the number of magnetized poles, R [mm] is a diameter of the circumferential surface to be magnetized in the case where one of the surfaces is magnetized, R [mm] is a diameter of the outer circumferential surface in the case where both of the inner circumferential surface and the outer circumferential surface are magnetized, and h [mm] is an axial height perpendicular to a radial direction of the material.

[c10] 10. A magnetizing method according to claim 5, wherein the diameter of the outer circumferential surface of the cylindrical material is 10 to 30 [mm];

a wall thickness in the radial direction is 0.5 to 3 [mm]; and

the magnetizing method satisfies the formula

$$3.0 \times 10^{-4} \leq Rs \leq 1.0 \times 10^{-3} \text{ [}\Omega\text{/sq.]} \qquad (4).$$

where Rs is the surface resistance of the attenuation body.

[c11] 11. A magnetizing method according to claim 7, wherein the diameter of the outer circumferential surface of the

cylindrical material is 10 to 30 [mm];
a wall thickness in the radial direction is 0.5 to 3 [mm];
and
the magnetizing method satisfies the formula

$$3.0 \times 10^{-4} \leq Rs \leq 1.0 \times 10^{-3}\ [\Omega/sq.] \qquad (4).$$

where Rs is the surface resistance of the attenuation body.

[c12] 12. A magnetizing method according to claim 9, wherein the diameter of the outer circumferential surface of the cylindrical material is 10 to 30 [mm];
a wall thickness in the radial direction is 0.5 to 3 [mm];
and
the magnetizing method satisfies the formula

$$3.0 \times 10^{-4} \leq Rs \leq 1.0 \times 10^{-3}\ [\Omega/sq.] \qquad (4).$$

where Rs is the surface resistance of the attenuation body.

[c13] 13. A permanent magnet magnetized in the magnetizing method according to claim 2, wherein the attenuation body is formed integrally with a surface of the material to make up a coating layer.

[c14] 14. A permanent magnet magnetized in the magnetizing method according to claim 5, wherein the attenuation body is formed integrally with a surface of the material to make up a coating layer.

[c15] 15. A permanent magnet magnetized in the magnetizing method according to claim 6, wherein the attenuation body is formed integrally with a surface of the material to make up a coating layer.

[c16] 16. A permanent magnet magnetized in the magnetizing method according to claim 8, wherein the attenuation body is formed integrally with a surface of the material to make up a coating layer.

[c17] 17. A permanent magnet magnetized in the magnetizing method according to claim 10, wherein the attenuation body is formed integrally with a surface of the material to make up a coating layer.

[c18] 18. A permanent magnet according to claim 13, wherein a resin layer is formed on the coating layer formed by the attenuation body.

[c19] 19. A permanent magnet according to claim 14, wherein a resin layer is formed on the coating layer formed by the attenuation body.

[c20] 20. A permanent magnet according to claim 17, wherein a resin layer is formed on the coating layer formed by the attenuation body.

[c21] 21. A motor, wherein the permanent magnet according

to claim 13 is a driving magnet.

[c22] 22. A motor, wherein the permanent magnet according to claim 14 is a driving magnet.

[c23] 23. A motor, wherein the permanent magnet according to claim 17 is a driving magnet.

[c24] 24. A motor, wherein the permanent magnet according to claim 18 is a driving magnet.

[c25] 25. A motor, wherein the permanent magnet according to claim 19 is a driving magnet.

[c26] 26. A motor, wherein the permanent magnet according to claim 20 is a driving magnet.

[c27] 27. A motor generating rotational driving force by interaction between a stator comprising a core and a plurality of coils wounded on the core, and a permanent magnet opposed to the stator,
wherein the permanent magnet used in the motor has a cylindrical shape; and a conductive attenuation body is formed integrally with, in contact with, or close to at least any one or both of an inner circumferential surface and an outer circumferential surface of the permanent magnet;
a surface resistance Rs of the attenuation body satisfies

the formula;

$$3.0 \times 10^{-5} \leq Rs \leq 1.0 \times 10^{-2}\ [\Omega/sq.] \qquad (1).$$

a material to be magnetized is a Nd-Fe-B bonded material; and

a geometry of a permanent magnet obtained from the material satisfies the formula

$$h < \pi R/P\ [mm] \qquad (3).$$

where R is a diameter of the inner circumferential surface or the outer circumferential surface in the case where one of the surfaces is magnetized, R is a diameter of the outer circumferential surface in the case where both of the inner circumferential surface and the outer circumferential surface are magnetized, P is the number of poles of the permanent magnet, and h is an axial length perpendicular to a radial direction.

[c28] 28. A motor generating rotational driving force by interaction between a stator comprising a core and a plurality of coils and a permanent magnet opposed to the core, wherein the permanent magnet used in the motor has a cylindrical shape; and at least any one or both of an inner circumferential surface and an outer circumferential surface of the permanent magnet are coated with a conductive attenuation body;

an attenuation body is integrally formed on the surface of the material;

a surface resistance Rs of the attenuation body satisfies the formula;

$$3.0 \times 10^{-5} \leq Rs \leq 1.0 \times 10^{-2}\ [\Omega/sq.] \qquad (1).$$

the material to be magnetized is a Nd-Fe-B based bond magnet; and
a geometry of a permanent magnet obtained from the material satisfies the formula

$$h < \pi R/P\ [mm] \qquad (3).$$

where R is a diameter of the inner circumferential surface or the outer circumferential surface in the case where one of the surfaces is magnetized, R is a diameter of the outer circumferential surface in the case where both of the inner circumferential surface and the outer circumferential surface are magnetized, P is the number of poles of the permanent magnets, and h is an axial length perpendicular to a radial direction;
further, the diameter of the outer circumferential surface of the material is not less than 10 [mm] and not more than 30 [mm], and a wall thickness in the radial direction is not less than 0.5 [mm] and not more than 3 [mm]; and still further, the surface of the attenuation body is painted with resin to be covered.